REMARKS

The rejection of Claims 1, 2 and 5-12 under 35 U.S.C. §102(b) as clearly anticipated by U.S. 5,616,024 (Nobori et al), is respectfully traversed.

The present invention relates to a ceramic heater useful for preparing semiconductors.

As described in the specification under "Background Art" beginning at page 1, line 8, it is known in the prior art to use ceramic heaters containing resistance heating elements on a surface thereof for heating semiconductor wafers and the like. Conventional heaters, having a resistance heating element in a pattern such as that shown in Figure 5 herein, results in non-uniform heating, and thus the semiconductor wafer or the like to be heated suffers from unevenness in temperature. The present invention successfully addresses these deficiencies of the prior art.

As recited in independent Claim 1, the present invention is a ceramic heater, comprising a resistance heating element arranged on a surface of a disc-shaped non-oxide ceramic substrate or inside the substrate, wherein the resistance heating element is divided into two or more circuits and comprises a mixture of a resistance heating element having a concentric or spiral pattern and a resistance heating element having a pattern of a winding line, and wherein the resistance heating element having the pattern of the winding line is formed at least in a peripheral portion of the substrate.

As recited in independent Claim 2, the present invention is also a ceramic heater, comprising a resistance heating element arranged on a surface of a disc-shaped non-oxide ceramic substrate or inside the substrate, wherein the resistance heating element is divided into two or more circuits and comprises a mixture of a resistance heating element having a concentric or spiral pattern and a resistance heating element having a pattern of repeated winding lines, and wherein the resistance heating element having the pattern of the repeated winding lines is formed at least in a peripheral portion of the substrate.

Thus, all the present claims are characterized by the presence of a non-oxide ceramic substrate, division into two or more circuits, and a resistance heating element having either a pattern of a winding line (Claim 1) or repeated winding lines (Claim 2) formed at least in a peripheral portion of the substrate.

The temperature in the peripheral portion of a ceramic heater comprising a resistance heating element arranged on a surface of a disc-shaped non-oxide ceramic substrate or inside the substrate tends to drop since a non-oxide ceramic has high thermal conductivity. The heat of the ceramic radiates or the atmospheric gas takes heat away from the ceramic. On the other hand, heat tends to accumulate in the central portion of the ceramic substrate so that the temperature in the central portion tends to rise. Thus, a temperature difference between the central portion and the peripheral portion is generated in this manner, which results in a lack of uniformity in temperature of the entire wafer-heating surface.

In order to solve this problem, the ceramic heater of the present invention comprises a resistance heating element having a pattern of a winding line or a pattern of repeated winding lines in a peripheral portion of a substrate, as discussed above. With this structure, heat density in the peripheral portion is maintained high, and the temperature thereof does not drop. The temperature uniformity of the whole wafer-heating surface is thus improved.

It is an essential prerequisite of the present invention that the ceramic heater comprises a non-oxide ceramic substrate. In addition, the present invention requires two indispensable features: a resistance heating element having a concentric or spiral pattern; and a resistance heating element having a pattern of a winding line or a pattern of repeated winding lines in the peripheral portion. The above-discussed property of temperature uniformity cannot be attained in the absence of either feature.

The above is neither disclosed nor suggested by the applied prior art.

Nobori et al discloses a ceramic heater comprising a ceramic substrate and a resistant heating element embedded within the substrate along a predetermined planar pattern, wherein the resistant heating element is obtained by heat-treating a convolution of a high melting point metallic, spiral-coiled filament at a temperature not higher than a primary recrystallization commencement temperature of the high melting point metal under a non-oxidative atmosphere, while the convolution is held in and along the predetermined pattern. See column 4, line 36ff. In Nobori et al, the resistant heating element is preferably divided into a peripheral portion and an inside portion of the substrate, which can control the heat radiation value of each of the resistant heating elements in respective portions, independently. In addition, in Figures 16 and 17 therein, two heating zones are supplied (column 21, line 55 through column 22, line 56). However, all of the resistant heating elements of Nobori et al are in a pattern composed only of a spiral convolution. Nobori et al neither discloses nor suggests the presently-recited mixture of Claims 1 or 2. In a pattern such as disclosed by Nobori et al, transmission of heat in the direction of the heater diameter becomes small and transmission of heat in the direction of the heater circumference becomes large. Thus, unevenness of temperature would be expected from Nobori et al's configurations.

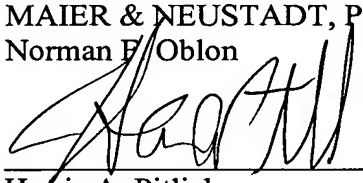
Contrary to the Examiner's findings, the resistant heating element according to Nobori et al does **not** comprise a pattern of a winding line. For example, Fig. 3b is a **plan view** of a convolution 13. The convolution 13 is produced from the spiral **coil** (column 11, lines 46-48). The loops 13b, which look like winding lines, have an increased distance between **successive coils** (column 11, lines 56-58), and thus do not have a pattern of a winding line. Therefore, the central portion and the peripheral portion of the ceramic substrate thereof both comprise a resistant heating element having only a spiral pattern. With such a structure, heat density in the peripheral portion is low, and temperature drop in the peripheral portion cannot be suppressed.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

All of the presently-pending claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.
Norman F. Oblon



Harris A. Pitlick
Registration No. 38,779

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/03)
NFO/HAP/cja